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PCB CONTAMINATED SOIL TREATMENT/DISPOSAL ALTERNATIVES

**Shaffer Equipment Site
Minden, West Virginia**

AR300033

Shaffer Equipment Disposal Alternatives

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Shaffer Equipment Disposal Alternatives

I. INTRODUCTION

A. Background

The Shaffer Equipment Company Site is located on West Virginia Route 17 in Minden, WV. Minden is a small coal town located in Fayette County with approximately 2000 residents. There are an estimated 65 to 75 people who live within 1/8 mile of the site. The Shaffer Equipment Company is an operating firm that builds electrical substations for the local coal mining industry. Many of their units incorporate various sizes of transformers, capacitors, switches and other voltage regulation/distribution devices. The company has operated since 1970. Past practices involved the storage of unneeded, damaged or outdated transformers and capacitors on the one-acre site. Leakage from these units and associated storage practices appears to be responsible for the severe PCB contamination problem that presently exists on the site.

The site is approximately one acre in size and contains a single building which is both a workshop/warehouse and office. The site is relatively flat and slopes toward the west. Arbuckle Creek is located downgradient and to the west and has been shown to contain PCB in the sediment (194 ppm).

PCB has been found in soils and sediment on site. Levels as high as 27% have been found in heavily stained soils. It is estimated that approximately 2000 cubic yards of soil have been contaminated with PCB in excess of 50 ppm. In addition, there are an estimated 150 transformers, 60 capacitors and 75 drums on site. Labels were found which indicate that some transformers and capacitors are filled with PCB fluids.

PCB-bearing transformers, capacitors and drums were currently removed from the Shaffer Equipment site. The waste material was transported to the General Electric facility in Philadelphia, PA. However, EPA is concerned about the optimum methodology to handle/dispose of the remaining estimated 2000 cubic yards of PCB contaminated soil. Therefore, this report addresses the current viable options available to control, stabilize, treat or dispose of the PCB contaminated soil in an environmentally safe and secure manner.

B. Goals and Objectives

Past experience with conventional disposal practices (landfilling) for immediate removal projects have demonstrated problems, including:

- Inaccessability to nearby landfills to accept hazardous waste material in a timely fashion.
- Inaccessability to nearby landfills has forced EPA, Region III to look at landfilling options as far west as California or Nevada and as far south as Alabama. Transportation costs are prohibitively expensive in such cases.
- Creation of a long-term responsibility at these current landfills where EPA can be considered a primary generator of the hazardous waste material.

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Shaffer Equipment Disposal Alternatives

1. Introduction (continued)

B. Goals and Objectives (continued)

Therefore, EPA must consider other options/technologies other than conventional landfilling that may not be cost effective from a short-term perspective, but are a viable alternative when evaluating the long-term ultimate disposal options...

Site specific detoxifications are currently available and must be evaluated accordingly.

There are also several advantages to consider when utilizing on-site specific treatment/detoxification or destruction technologies, including:

- Promote RCRA (i.e. promote resources conservation and recovery).
- Minimize use of valuable off-site land (resources).
- Eliminate transportation costs to disposal facilities.
- Eliminate public threat on highways when transporting hazardous material.
- Eliminate EPA's liability as hazardous waste generator should landfill for EPA removal project fail.
- Promote innovative state-of-the-art technology.

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Shaffer Equipment Disposal Alternatives

II. STABILIZATION, TREATMENT AND DISPOSAL OPTIONS FOR PCB CONTAMINATED SOIL

A. General

There are a variety of options/alternatives that can be utilized to stabilize the Shaffer Equipment site. Each option/alternative has its advantages/disadvantages. A list of options/alternatives is present in Table 1. A thorough assessment of each technology was necessary to determine the technical and practical feasibility of these technologies. The assessment criteria was based on the following factors as they pertain to the Shaffer Equipment site:

- Technology performance
- Versatility
- Incremental residual volume of hazardous material
- Mobility/transportability
- Safety
- Additional treatment requirements
- Area/volume limitations
- Future land use
- Contaminant interferences
- Costs
- Pollution aspects (e.g. air, water, groundwater)
- Permitting technology (e.g. air permit)

B. Technologies

1. Mobile Incineration with a Rotary Kiln

a. Description

Rotary kiln incinerators are versatile units that have sufficient design feasibility to ensure thermal destruction of organic contaminants. The contaminated waste stream is fed into a rotary kiln, which is a cylindrical horizontal shell mounted at a slight downward incline. A typical rotary kiln is designed with a length of 2 to 10 times the diameter and a rotational speed of 1 to 5 rpm. Operating temperatures are between 1,500 to 3,000°F. Design parameters are dependent on the contaminant, nature and concentrations of the waste stream.

Excess air is used to ensure complete combustion. Ash and non-oxidized materials are collected and are either returned to the original site or removed for disposal. Most kiln systems are designed with an afterburner to permit complete destruction of all contaminants. Effluent gas is cooled, passed through a scrubber to remove particulates and then released to the atmosphere.

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Shaffer Equipment Disposal Alternatives

11. Stabilization, Treatment and Disposal Options for PCB Contaminated Soil
(continued)

B. Technologies (continued)

1. Mobile Incineration with a Rotary Kiln (continued)

b. Commercial Availability

* Energy Conservation Corp.
South Hampton, PA
(215) 358-5440
Contact: Ben Schranz

* Canavan Technology, Inc.
P.O. Box 6016
Bridgewater, NJ 08807
(201) 725-0888
Contact: David P. Norris

c. Costs

The present cost of utilizing a mobile incinerator is highly dependent on the quantity of material requiring incineration. For a project of magnitude such as Shaffer Equipment, costs per cubic yard range from \$600 to \$1,000 each. It is estimated that with larger projects, costs could be reduced to \$100/yards.

d. Time Frame

Upon notification, a mobile incinerator could be mobilized in three weeks. At the loading rate of 6,000 lb/hr. (highest presently available) approximately 3 months would be required to incinerate the waste on site.

2. Microwave Plasma Detoxification

a. Description

Microwave plasma is an ionized gas (may be inert or other) produced via microwave-induced electron reactions with neutral gas molecules. In a gas under reduced pressure (100-200 torr), a few low energy electrons are accelerated by the microwave electromagnetic field causing collisions with other gas molecules and generating additional charged ions. The continuation of this process forms a plasma.

By operating under these conditions it is possible to maintain the free electrons at high temperatures without heating the bulk gas. The system's mechanism is principally electronic, rather than thermal, so low equipment temperatures can be maintained, thus reducing the cost of the materials of construction. In addition, the systems are leak-tight due to the vacuum requirements, resulting in a high level of safety in operation.

The system may produce hazardous by-products (this depends on the gas used as a plasma generator).

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Shaffer Equipment Disposal Alternatives

II. Stabilization, Treatment and Disposal Options for PCB Contaminated Soil (continued)

B. Technologies (continued)

2. Microwave Plasma Detoxification (continued)

b. Applicability

- 1) The system has been tested for decomposition of toxic gases used by the U.S. Army in a laboratory-scale operation.
- 2) Equipment has been developed with a waste stream feed capacity of 30 pounds/hour.
- 3) This system has been shown to be highly effective for the detoxification/destruction of hazardous organic wastes, including PCB, methyl bromide and polyaromatic dye mixtures.
- 4) No experience with soils has been reported.

c. Comments

- 1) Toxic materials may result from contaminant degradation. The actual products depend on the contaminant, as well as the gas used as the plasma. These materials leave the system as both gases and solids.
- 2) Cost information (June 1978): Capital cost: \$100,000 per unit (50 pounds/hour capacity; operating cost for detoxification of phenylmercuric acetate solution: \$380 per ton.
- 3) At the destruction rate of 50 lb/hr. it would require 27.5 years to completely detoxify the waste stream at Shaffer Equipment.
- 4) Due to this small acceptance quantity it is unfeasible at this point to utilize this technology.

3. High Temperature Fluid Wall

a. Description

The high temperature fluid wall reactor is being developed by J.M. Hubner, Inc. to detoxify solid waste by way of thermal destruction. Contaminated waste material is gravity fed into a porous tube that uses electrical heating elements to radiate thermal energy. Inert gas is forced through the tube creating a fluid wall so that there is essentially no physical contact between the tube and the feed material. This reduces operational problems and ensures longer equipment life. The reactor operates in a nitrogen atmosphere at 4,000 to 5,000°F at low pressures. Waste material is brought to this temperature in a fraction of a second, and the chemicals are broken down into their atomic constituents. The treated soil becomes a non-hazardous, sand-like material.

b. Applicability

- 1) The system has been tested with PCB contaminated soil.
- 2) A commercial reactor is available with a rating of 50,000 tons/year capacity.
- 3) Soils and solids must be prepared (ground) to a uniform state prior to being decontaminated.

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Shaffer Equipment Disposal Alternatives

II. Stabilization, Treatment And Disposal Options for PCB Contaminated Soil (continued)

B. Technologies (continued)

3. High Temperature Fluid Wall (continued)

c. Comments

- 1) Waste material from this process is likely to be non-hazardous due to the high temperatures.
- 2) The system is likely to produce low to medium synthetic gas when handling organic contaminants, thus reducing new energy costs.
- 3) Treated material from the system may be returned to the original contaminated site.
- 4) Cost estimated at \$300 to \$1,500/ton.
- 5) A 3" and a 9" reactor are currently available on the market. There are no current contractual arrangements for hire.

4. Solvent Extraction (on-site)

a. Description

Solvent extraction or leaching of waste streams is the process of separating soluble organic or inorganic compounds by bringing the contaminants into contact with an appropriate solvent. Contaminated wastes will be placed in an extraction vessel and then washed with the appropriate solvent. This process is shown on Figure 21. The solvent should be chosen based on its ability to desorb the contaminant from the waste, and the ease of separating the solvent from the adsorbed contaminant.

After washing the soil it is dried and can possibly be returned to the site. The solvent is recovered using typical liquid recovery processes, such as distillation, while the contaminant is concentrated in any remaining solvent. The concentrated solvent is then destroyed on site or may be further processed. This process can be designed to recover most contaminants.

b. Comments

- Solvent extraction produces a concentrated waste stream that must be treated.

5. Solvent Extraction (in-situ)

a. Description

Solvent extraction in-situ (Figure 25) relies on the same chemical and physical properties as on-site solvent extraction. The difference is that the contaminated soil is not removed from its original site - it is treated in place. For successful solvent extraction the contamination must be defined and possibly isolated using any containment technology. Injection and vacuum wells are then located on the contaminated site based on the area's geography and geological structure.

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Shaffer Equipment Disposal Alternatives

II. Stabilization, Treatment and Disposal Options for PCB Contaminated Soil
(continued)

B. Technologies (continued)

5. Solvent Extraction (in-situ) (continued)

a. Description (continued)

The selected solvent is injected into the contaminated site and allowed to leach contaminants from the soil. The solvent is then withdrawn via the vacuum wells and pumped to a solvent recovery unit. Here the contaminants are concentrated and then destroyed or further processed. The recovered solvent is injected back into the contaminated zone for further leaching (extraction) of contaminants.

b. Applicability

- 1) This process is used for in-situ mining of uranium using sulfuric acid as the solvent.
- 2) EPA has used this process to recover water-soluble contaminants.
- 3) Different soil types may hinder solvent contact with the soil.
- 4) This process is difficult to control (solvent may channel through soils).
- 5) The system can be designed to be mobile.
- 6) This unit process can easily be integrated with other processes to form a successful treatment system.

c. Comments

- 1) Solvents needed to successfully decontaminate soil may cause ground-water contamination.
- 2) Due to the perched water table the adjacent stream and the spring undermine the site--controlling the injected solvents would be impossible. Therefore, the solvent extraction (in-situ) would not be feasible in this situation.

6. Decontamination of Soils using Franklin Solvent

a. Description

The Franklin solvent is a proprietary compound that is believed to be a sodium polyethylene glycol mixture. This compound reacts with toxic chlorinated organic compounds to form nontoxic products (the chlorides will react with the sodium, forming a salt). This solvent is applied directly to contaminated soils and allowed to react in-situ. No further treatment would be necessary as the reaction products and solvent are biodegradable and nontoxic.

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Shaffer Equipment Disposal Alternatives

II. Stabilization, Treatment and Disposal Options for PCB Contaminated Soil
(continued)

B. Technologies (continued)

6. Decontamination of Soils using Franklin Solvent (continued)

b. Applicability

- 1) This process has been demonstrated in the laboratory to dechlorinate polychlorinated biphenyls (PCB).
- 2) This process is scheduled for in-situ field testing in Buffalo, NY, beginning on August 23, 1983 by EPA research.
- 3) There are possible side reactions that could form phenyls or biphenyls.

c. Comments

- 1) Products of in-situ treatment are NaCl and other nontoxic glycolic organics (exact composition is unknown). The organics should be very susceptible to natural biodegradation.
- 2) This system has the potential to be extremely cost effective.
- 3) Groundwater contamination may occur from in-situ treatment as a result of the increased mobility of hazardous compounds.
- 4) As in the solvent extraction in-situ, due to the perched water table, the adjacent stream and the spring undermining the site, this method would not be feasible due to the uncontrolled nature of the solvent application and possible side reactions that would form from phenyls or biphenyls.

7. Solvent Extraction using the Acurex Process

a. Description

Organics-contaminated soil is excavated and placed into modular soil-washing vessels, as illustrated in Figures 23 and 24. The soil is washed with an organic solvent that is made up of several blended compounds and is considered proprietary by Acurex. The contaminated solvent is then removed via vacuum extraction and is transferred to the solvent recovery area. The soil is dried and placed in a suitable location.

The contaminated solvent is fed to a column where the solvent is reclaimed. Contaminants are concentrated at the bottom of the recovery columns and sent to a reactor vessel. In this vessel the Acurex reagent (proprietary) is added that reacts with the toxic material forming a nontoxic sludge that must be disposed of.

b. Applicability

- 1) The system is not available commercially, but has been tested in the field by EPA. Acurex hopes to have a demonstration by May, 1984 and is currently seeking funding for such a project.
- 2) The system was developed to remove chlorinated organics from soils (e.g. PCB).

Shaffer Equipment Disposal Alternatives

II. Stabilization, Treatment and Disposal Options for PCB Contaminated Soil (continued)

B. Technologies (continued)

7. Solvent Extraction using the Acurex Process (continued)

b. Applicability (continued)

- 3) The system has been developed to be mobile.
- 4) The effect that metals have on the efficiency of this process is unknown at this time.

c. Comments

- 1) The sludge stream generated requires disposal.
- 2) Residual solvent may be adsorbed by soil.
- 3) Cleanup cost estimate: \$200 to \$500/cubic yd. (June, 1983).

d. Availability

Acurex, Inc. in Cincinnati, Ohio has lab-tested a scale model of this process of PCB in soil on a 55-gallon basis/day. Acurex is designing a system that can extract 10 cubic yards of material/day. This mobile system will be available for commercial use in September, 1985.

8. Slurry Wall

a. Description

Slurry walls provide impenetrable subsurface barriers to any lateral migration of the contaminants present at a specific site. A trench is constructed that is 3 to 5 feet wide and deep enough to connect with the impervious aquiclude. Trench construction is either by excavation or by vibrated beam injection of a self-hardening slurry. During excavation, the trench is filled with a slurry of bentonite clay and water.

The hydrostatic pressure of the slurry on the trench walls prevents their collapse. Excavation in the water-saturated soil below the surface of the water table forms trench walls that are particularly susceptible to collapse. The slurry also produces a low-permeability filter cake of bentonite that lines the trench walls and bottom. The trench is then back-filled with a material of low permeability. Common fills are soil-bentonite, cement-bentonite and concrete. Cement-bentonite, or coulis, is a self-hardening slurry and backfilling is not necessary.

b. Applicability

- 1) The expense and feasibility are site-specific, depending on location, ease of access, geography, etc.
- 2) Slurry walls have been used in the construction industry since the 1940's. Europeans have also used the walls to contain lagoons and control the water table, but slurry walls are a relatively new technology in the U.S. A typical application of slurry wall containment is shown in Figure 43.

Shaffer Equipment Disposal Alternatives

II. Stabilization, Treatment and Disposal Options for PCB Contaminated Soil
(continued)

B. Technologies (continued)

8. Slurry Wall (continued)

c. Comments

- 1) Slurry walls only contain the contaminants, and so are usually used in conjunction with desensitization methods.
- 2) The presence of certain organic chemicals can alter the permeability of the wall.
- 3) The slurry wall contains lateral migration and should be used in conjunction with an impenetrable subsurface barrier such as clay.

d. Availability

Geo-Con, Inc.
P.O. Box 17380
Pittsburgh, PA 15235
(412) 244-8200; Contact: Mason Wheeler

Based on a phone conversation with Mason Wheeler on 2/18/85, a site description was relayed for an estimate to contain the site with a slurry wall. -

Assuming the site is 1-1 acres in size and the slurry wall is to be installed at an approximate depth of 6', with a questionable underground geologic structure, an estimate price quote of \$25,740 was given to contain the site with a slurry wall.

ICOS, Inc.
4 West 58th Street
New York, NY 10019
(212) 688-9216; Contact: Nino Catal

Based on the same assumed specifications via communications, an estimated price quote of \$93,000 basis 1300-6' depth at \$12 per sq. ft. to contain the site.

9. Grouting

a. Description

Grout injection installs an impenetratable subsurface barrier that prevents the migration of contaminants. An injection hole is constructed either with a vibrated beam or drill. A thixotropic fluid material is pressure injected into the soil or rock. Grouting materials can be either certain Newtonian chemicals (e.g., bitumens, organic polymers) or colloidal suspensions of cement or bentonite in water. The fluid sets, producing a strong solid with low permeability. The hardened grout has a low permeability and will be an effective barrier to groundwater migration.

Shaffer Equipment Disposal Alternatives

II. Stabilization, Treatment and Disposal Options for PCB Contaminated Soil
(continued)

B. Technologies (continued)

9. Grouting (continued)

a. Description (continued)

There are three types of grout:

- 1) Area blanket grout - for sealing shallow soils.
- 2) High pressure or "jet" grout - for use at depth, to seal a slurry wall panel (concrete walls are installed as panels) to the aquiclude.
- 3) Contact - to seal water flow passages at the outer surface of an excavation. It can be used when a slurry wall cannot be directly connected to the aquiclude because of a rock formation that would be difficult to excavate. Figure 44 illustrates a typical application of grout injection.

b. Applicability

- 1) Grouting is most commonly used for tunnel and dam construction, with the grout strengthening the soil or rock and not permitting water to pass.
- 2) EPA is studying this process as a method of isolating disposal sites with a grout lining on the bottom and the walls.
- 3) Grouting has not been used extensively, and is still in the development stage as a method for groundwater control.
- 4) Because grouting is only a containment technology, it would most likely be used in conjunction with a desensitization technology.

10. Microencapsulation

a. Description

In this process, excavated waste is mixed with an inert immobilizing agent in an on-site extruder operating at 130 to 230°C. When the mixture solidifies, contaminant particulates are dispersed and encased within a matrix. Matrix materials are thermoplastics such as asphalt, paraffin, bitumen and certain organic polymers such as polyethylene or polystyrene. The matrix: Waste ratio varies from 1:1 to 1:2 on a dry weight basis.

The solid product has a low permeability to prevent leaching. The contaminant is isolated from the environment in a solid that is resistant to weathering or biological attack. A secondary container, such as a polyethylene jacket or a steel drum, may be used to prevent surface leaching. The contained waste is then disposed of in a nonsecure landfill, or could possibly be used as a construction material.

A variation of this process is returning the extruded material to the excavated site and letting it harden in the ground.

Shaffer Equipment Disposal Alternatives

II. Stabilization, Treatment and Disposal Options for PCB Contaminated Soil
(continued)

B. Technologies (continued)

10. Microencapsulation

b. Applicability

- 1) Microencapsulation is most commonly used for high toxicity, low volume wastes.
- 2) The cost of this process depends on the choice of matrix material; however, it is considered a more expensive treatment than secure landfills. Organic polymer agents are substantially more expensive than other matrix materials.
- 3) Mobile equipment is used for microencapsulation; operating costs are high.

c. Comments

- 1) Certain organic compounds will dissolve organic thermoplastic materials; asphalt can then be used as the immobilizing agent in these cases.
- 2) If the solid matrix is fractured, leaching of waste will occur. Final disposal must avoid endangering the physical integrity of the solid.
- 3) Many of the vendors of microencapsulation processes own the exclusive patent rights to their specific matrix material.
- 4) S-Cubed Company is currently investigating sludge encapsulation techniques for USATHAMA.

11. Macroencapsulation

a. Description

In this process dried waste is pressed together under high temperature and pressure to induce fusion. An inert polymer coating, such as polyethylene or a urea-formaldehyde (UF) system, is fused around the solid block and dried. The contaminant is thus isolated from environmental forces and may be disposed of in a nonsecure landfill.

One variation has resulted from the problems encountered due to lack of adhesion between the coating and the fused waste block. A binding agent may be mixed in with the waste and adhesion is improved through the chemical affinity between the jacket and the binding agent.

b. Applicability

- 1) This is a well-developed technology used for both organic and inorganic wastes.
- 2) Mobile on-site treatment units are used, but this is still an expensive process because of the costs of drying; also, resin is more expensive than stabilizing agents.

Shaffer Equipment Disposal Alternatives

II. Stabilization, Treatment and Disposal Options for PCB Contaminated Soil (continued)

B. Technologies (continued)

11. Macroencapsulation (continued)

c. Comments

- 1) Polyethylene is combustible and the method of final disposal must consider this hazard.
- 2) It is advantageous to reduce the volume of contaminated material by pretreating the waste with volume reduction techniques (e.g. stripping, extraction, etc.).
- 3) If the jacket is fractured, contaminants will be released. Final disposal should be designed to avoid undue mechanical stresses that could breach the coating material.
- 4) Less reagent is needed with macroencapsulation than with microencapsulation or stabilization. However, organic polymer reagents are substantially more expensive than other fixation agents.
- 5) Due to the large quantity of materials present on the Shaffer Equipment Co. site the macroencapsulation technique would have to be used with volume reduction options prior to considering this process. Also, due to the wet nature of the site and low groundwater problems, the problem of drying the materials prior to encapsulation would be excessively expensive.

12. Fixation/Stabilization

a. Fixation (pretreatment) Description

Fixation processes improve the physical or chemical condition of a waste to minimize its movement within a contaminated site. Fixation can be a precursor to another treatment or it can be the final step before disposal. The two types of treatment are chemical treatment (e.g. pH adjustment) and solidification (e.g. stabilization, encapsulation). These will be discussed in detail in subsequent subsections.

Many wastes require chemical pretreatment to remove contaminants that are incompatible with each other or with the subsequent treatment process. Solidification is performed to transform the waste into a more convenient form for transport or disposal and to prevent leaching. The goal of fixation is to permit final disposal in a nonsecured landfill.

b. Stabilization (chemical admixing) Description

Similar to microencapsulation, stabilization also immobilizes the waste within a solid matrix. Stabilization, however, involves a chemical reaction that binds the waste to the admixture material. This chemical affinity stabilizes the resulting solid to make it more resistant to chemical and mechanical stresses.

Shaffer Equipment Disposal Alternatives

II. Stabilization, Treatment and Disposal Options for PCB Contaminated Soil (continued)

B. Technologies (continued)

12. Fixation/Stabilization (continued)

b. Stabilization (chemical admixing) Description (continued)

Waste is slurried with water and mixed with a fixation agent. The mixture that is produced dries as water either evaporates or is consumed in the binding reaction. The resulting solid has low permeability and can be discharged directly into an unsecured landfill and allowed to set. Because of the stability of the rock-like product, a secondary container is seldom used, although a surface sealant may be necessary to prevent leaching.

There are two types of fixation processes, i.e., cement-based and pozzolanic. Cement-based fixation (see Figure 45) uses powdered cement as the stabilization agent. Cementation occurs with the addition of water to the anhydrous powder. Pozzolanic fixation (see Figure 46), also called lime-based fixation, uses a blend of lime and a siliceous material such as fly ash. This mixture will react with water to form pozzolanic concrete.

The final solid has physical strength, but the monolith is not resistant to weathering. A disposal alternative is using the solid as a construction material. Stabilization products have been used for runway and roadway foundations and dike supports.

c. Applicability

- 1) Stabilization is an established technology in Europe and the U.S., especially for radioactive wastes and heavy metals.
- 2) Inorganic wastes are easily stabilized. Metals will form insoluble metal hydroxides and carbonates.
- 3) Organic concentrations above 10% can have a detrimental effect on matrix stability. Also, certain contaminants may act as setting retarders. Additives are available that can counteract these problems.
- 4) Stabilization is best suited for high volume, low toxicity wastes.

13. Hazardous Waste Landfill (on site)

The best engineering technology for hazardous waste landfills is to line the landfill cell with either a synthetic liner or utilize clay. The type of materials present on site and/or the availability of clay in the area will dictate the use of a synthetic or clay liner.

Synthetic liner installed \$ 58,316

Sand base with clay base on top of liner and clay to cap the landfill with 6" topsoil to cover the entire landfill.

- Sand - 400 yds. @ \$40/yd.	=	\$ 16,000
- Clay - 800 yds. @ \$50/yd.	=	40,000
- Topsoil - 400 yds. @ \$30/yd.	=	12,000
- Topsoil - installed	=	17,000
- Hydroseed	=	500
TOTAL		\$143,816

Shaffer Equipment Disposal Alternatives

II. Stabilization, Treatment and Disposal Options for PCB Contaminated Soil
(continued)

B. Technologies (continued)

13. Hazardous Waste Landfill (on site) (continued)

a. Calculations for On-site Landfill Areas (as of 2/19/85, Tuesday)

1) Approximate length - 11" x 45 = 500'

2) Approximate width - 2.5" x 45 = 113'

3) Total area of the site

$$\frac{500' \times 113'}{9 \times 4840} = 1.3 \text{ acre}$$

4) Soil volume (depth of excavation 1.5')

$$\text{vol.} = \frac{1.5' \times 500' \times 113'}{27} = 3138 \text{ (approx. 3200 cu. yds.)}$$

5) One-third of the area will be used to dump the contaminated soil.

$$\frac{500' \times 113'}{3} = 18833 \text{ ft.}^2$$

6) One side of the pile = 113'

$$\text{Length} = \frac{18833}{113} = 167'$$

Area of the plastic sheet 113'

+113'

+167'

+167'

$$560' \times 1.5 = 840 \text{ ft.}^2 \text{ (approx. 1000 ft.}^2\text{)}$$

$$18871 \text{ ft.}^2 + 840 \text{ ft.}^2 = 19,711 \text{ ft.}^2 \text{ <-- area of plastic sheet}$$

1/3 of an acre (approx. \$40,000)

$$= \frac{4840 \text{ sq. yds.}}{3}$$

$$= 4840 \times 3 = 13,520 \text{ ft.}^2 \text{ (approx. \$40,000)}$$

for 13,520 ft.² -----> \$40,000

for 19,711 ft.² we need \$58,316.56

Shaffer Equipment Disposal Alternatives

II. Stabilization, Treatment and Disposal Options for PCB Contaminated Soil
(continued)

B. Technologies (continued)

14. Hazardous Waste Landfill (off site)

Current available off-site landfills that are accepting PCB materials are:

	<u>Disposal Price</u>
Chemical Waste Mgmt. Kettleman Hills, CA	\$162/yd + 5% tax \$9.92/yd <1200 ppm \$19.84/yd >1200 ppm
Chemical Waste Mgmt. Emelle, Alabama	\$140/ton + tax
SCA Chemical Div. of Chemical Waste Mgmt. Model City, NY 14107 (716) 754-8731	\$140/ton + tax

Landfill Cost Figures

24,000 cu. yds. x \$140	=	\$560,000
\$560,000 x 5% tax	=	<u>28,000</u>
Approximate Total		\$588,000

Transportation Costs

Minden, WV to Emelle AL
700 miles @ \$3/mile = \$2,100 x 235 truckloads = \$493,500.00

Minden, WV to Model City, NY
450 miles @ \$3/mile = \$1,350 x 235 truckloads = \$317,250.00

Minden, WV to Beatty, NV
2100 miles @ \$3/mile = \$6,300 x 235 truckloads = \$1,480,500.00

Shaffer Equipment Disposal Alternatives

II. Stabilization, Treatment and Disposal Options for PCB Contaminated Soil
(continued)

B. Technologies (continued)

15. Off-Site Incinerators

Current available off-site permitted commercial incinerators are:

Rollins
Deer Park, TX

SCA
Chicago, IL

ENSCO
El Dorado, AR

All materials must be drummed to be properly packaged for incineration acceptance criteria.

It is estimated that to drum 4,000 cubic yards of materials it would require 16,000 drums to properly package same. The extra weight of the drums would also have to be entered into the total cost of incineration. This adds 280 tons to the disposal cost.

The total cost to incinerate the soils would be between \$8 and 10 million.

300050

Shaffer Equipment Disposal Alternatives

III. FEASIBILITY ANALYSIS

The stabilization, treatment and disposal alternatives were evaluated in Section 2.0 to determine viable options/alternatives for handling the PCB contaminated soils at Shaffer Equipment. The evaluation summary is presented in Table 2, in which each alternative was assessed according to availability, costs, time frame, environmental factor, commercial availability, institutional factor, handling problems and other pertinent factors.

The assessment identified two promising innovative technologies:

- Incineration (on-site) - mobile/transportable
- Solvent Extraction - mobile unit

As expected, conventional landfilling was the most cost effective alternative with the aforementioned alternative being approximately twice the cost of landfilling. Although on-site stabilization techniques (e.g. fixation, on-site landfills, etc.) were found to be the least expensive alternative, they are not preferred options from EPA's perspective for the following reasons:

- The PCB waste still remains on site.
- Public acceptability.
- High water table and an underground spring do not lend to stabilization process.
- Soils with high PCB concentrations may not be amendable to stabilization/encapsulation process (i.e. PCB may leach).
- Site is located in the flood plain.

IV. CONCLUSION

Two innovative technologies have been identified as the most viable alternative: Mobile incineration and solvent extraction. Costs are approximately double that of conventional landfilling. System availability of the mobile incineration unit is approximately one (1) month and that of the solvent extraction system is two (2) months. Since we are operating under an emergency situation it is suggested that the following decisions be determined as soon as possible:

- Duration soils can be staged prior to treatment/disposal.
- Decision to proceed with innovative technologies at double the price of conventional technology.

If the decision is made to proceed with innovative technologies, both mobile/transportable incineration and the solvent extraction system can be obtained in a timely fashion.

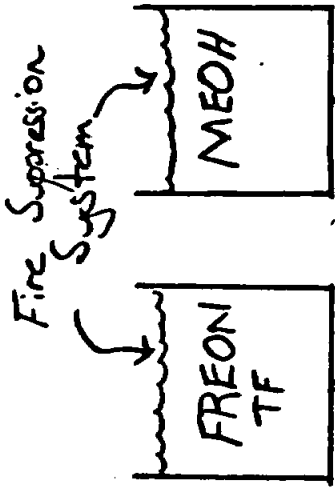
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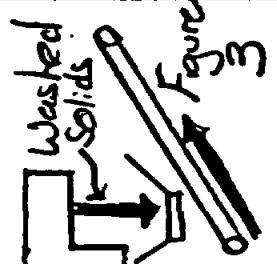
Shaffer Equipment

Solvent Extraction Of PCB Contaminated Soils



Blending

Fire Suppression System



Screw Conveyor

Contaminated Soil
Staging Cell

Drying Beds

300052

Soil Particle
Sizing/Sorting

Soils to Fines

Bag Filter

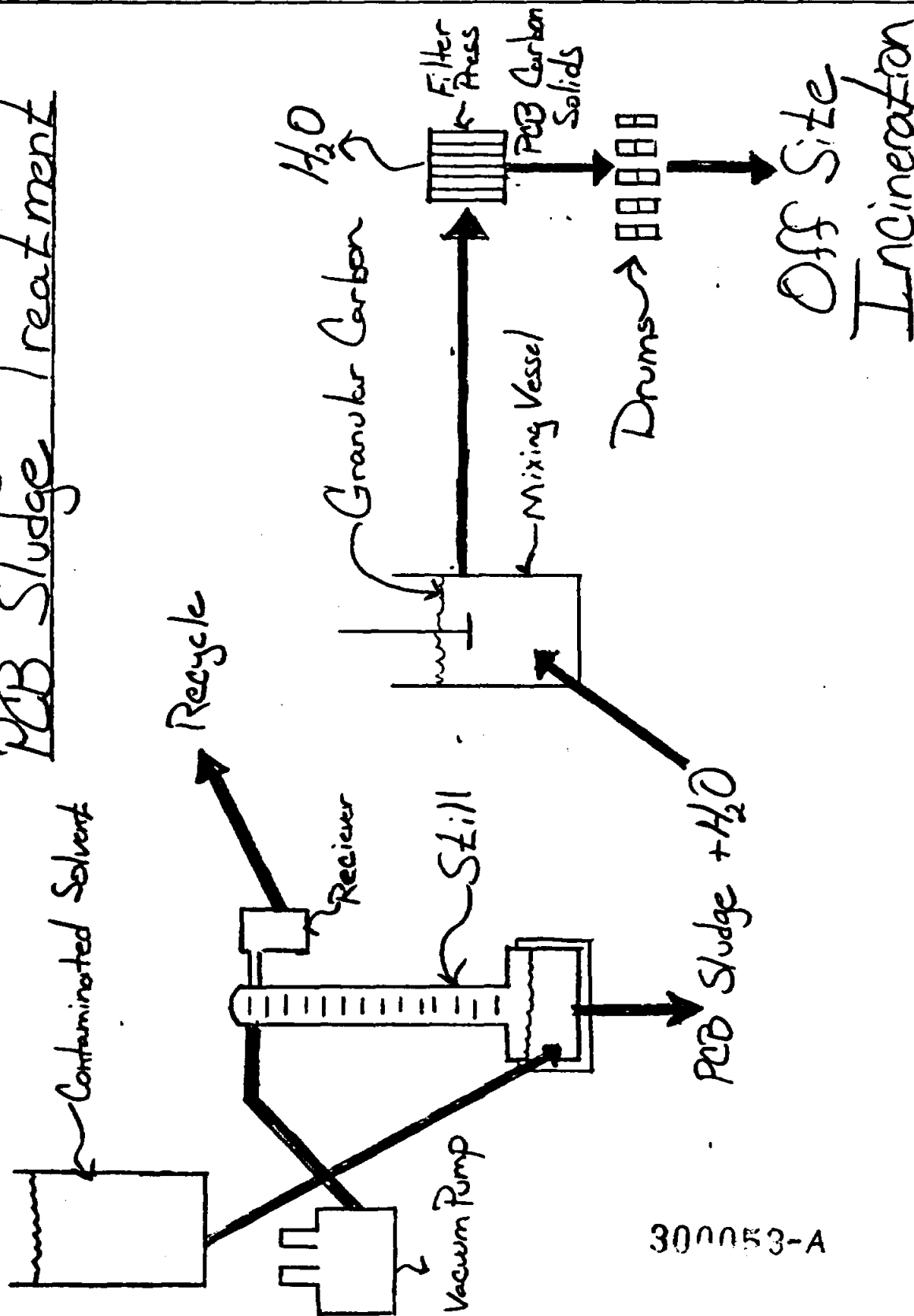
Contaminated Solvent

Figure 2

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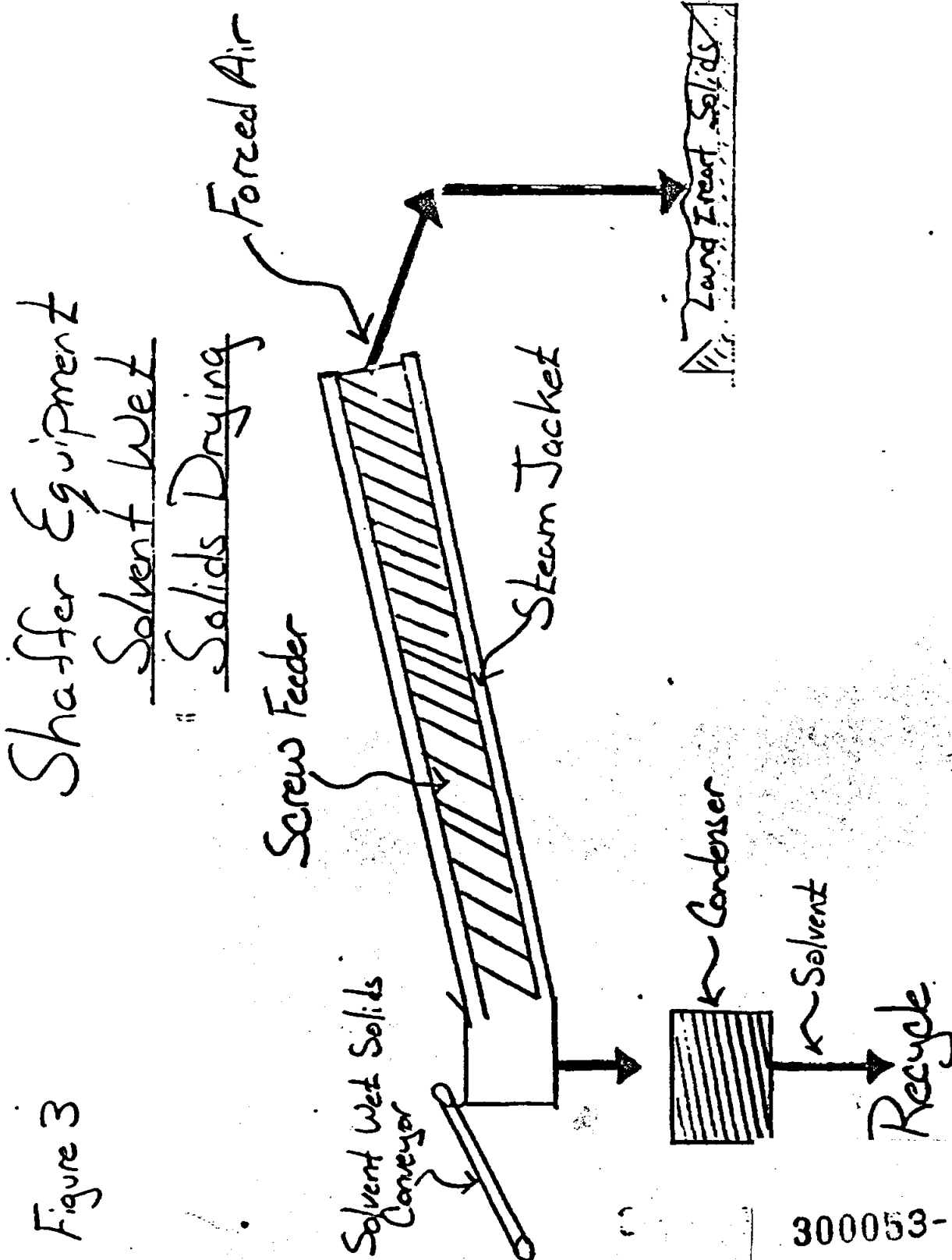
Shaffer Equipment

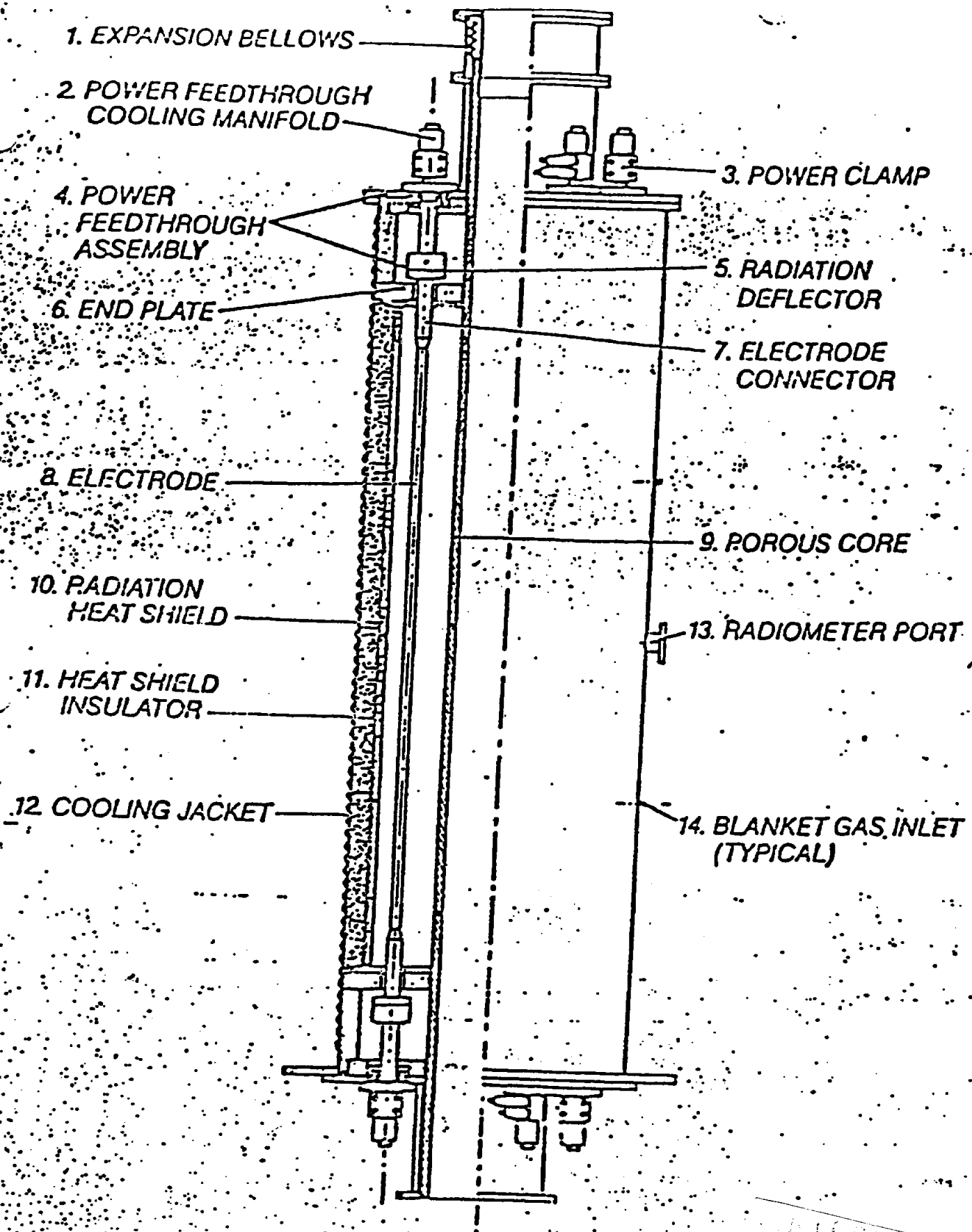
Solvent Recycle PCB Sludge Treatment



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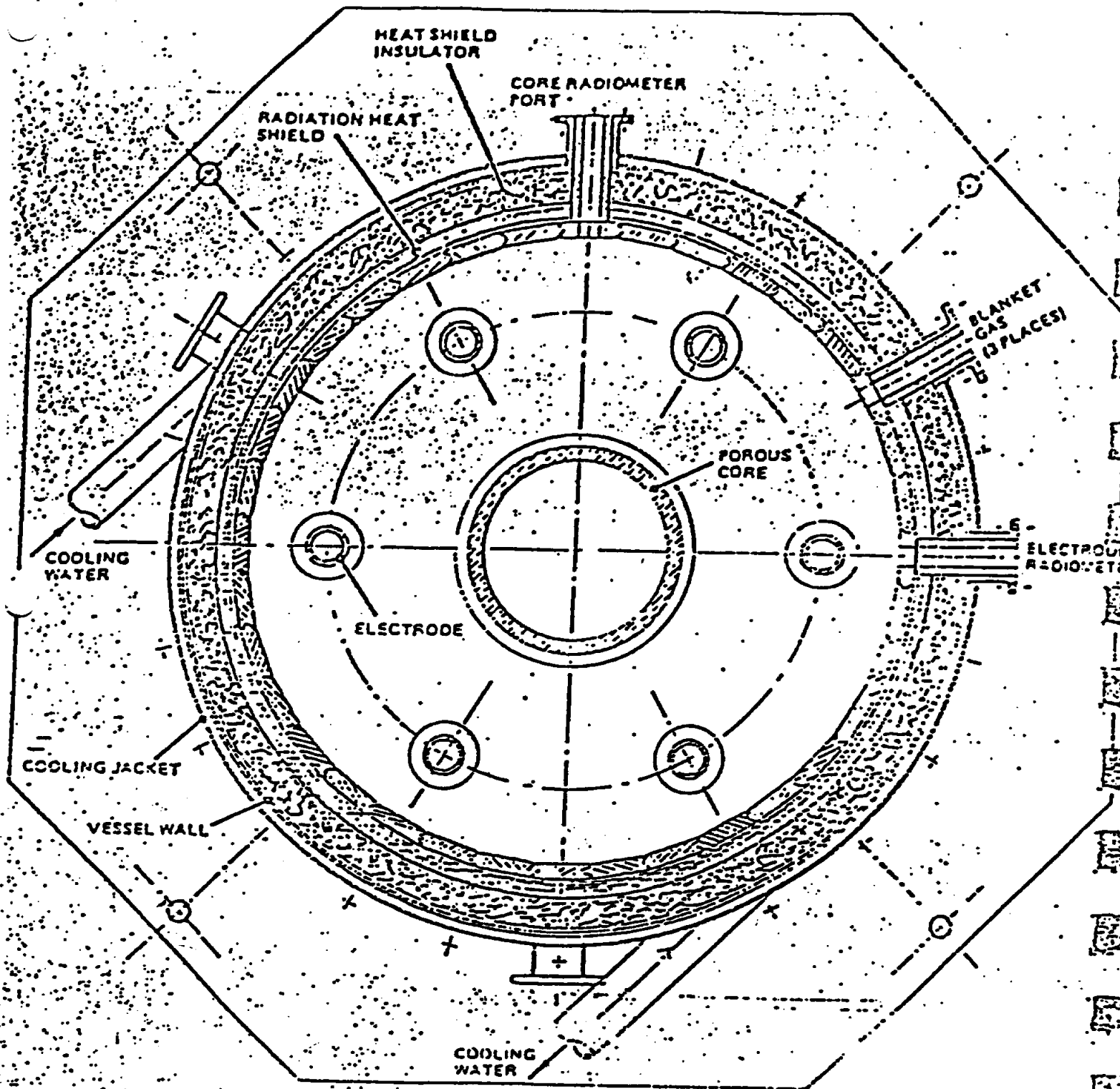




Source: Huber Technology Fluid Wall (HTFW) Reactor, 1983

Figure 17. Profile of a high-temperature fluid wall reactor.

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Source: Huber Technology Fluid Wall (HFW) Reactor, 1963

Figure 18. Cross section of a high-temperature fluid wall reactor.

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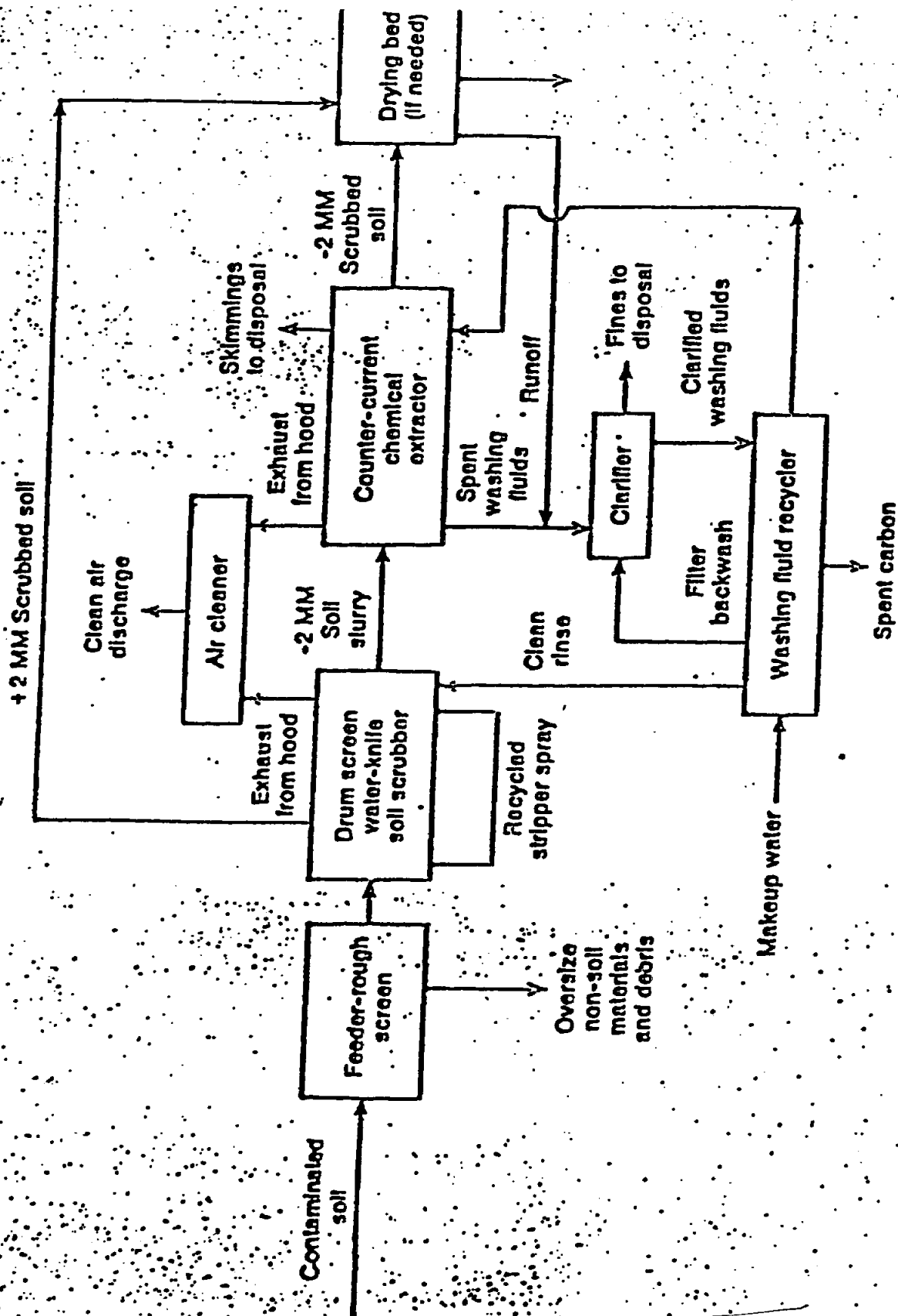


Figure 21. Typical on-site solvent extraction process for soils.

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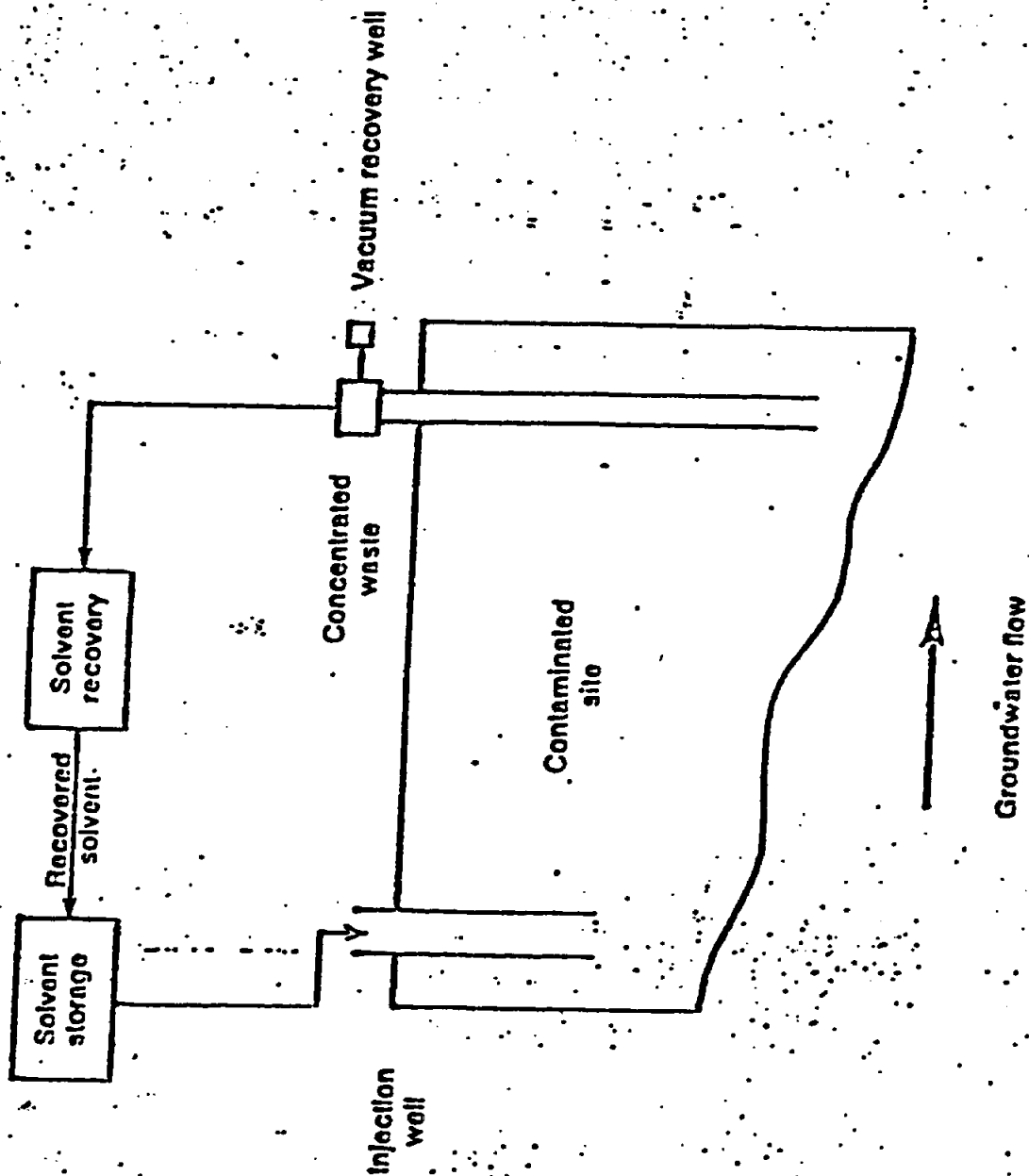


Figure 25. In-situ solvent extraction — process schematic.

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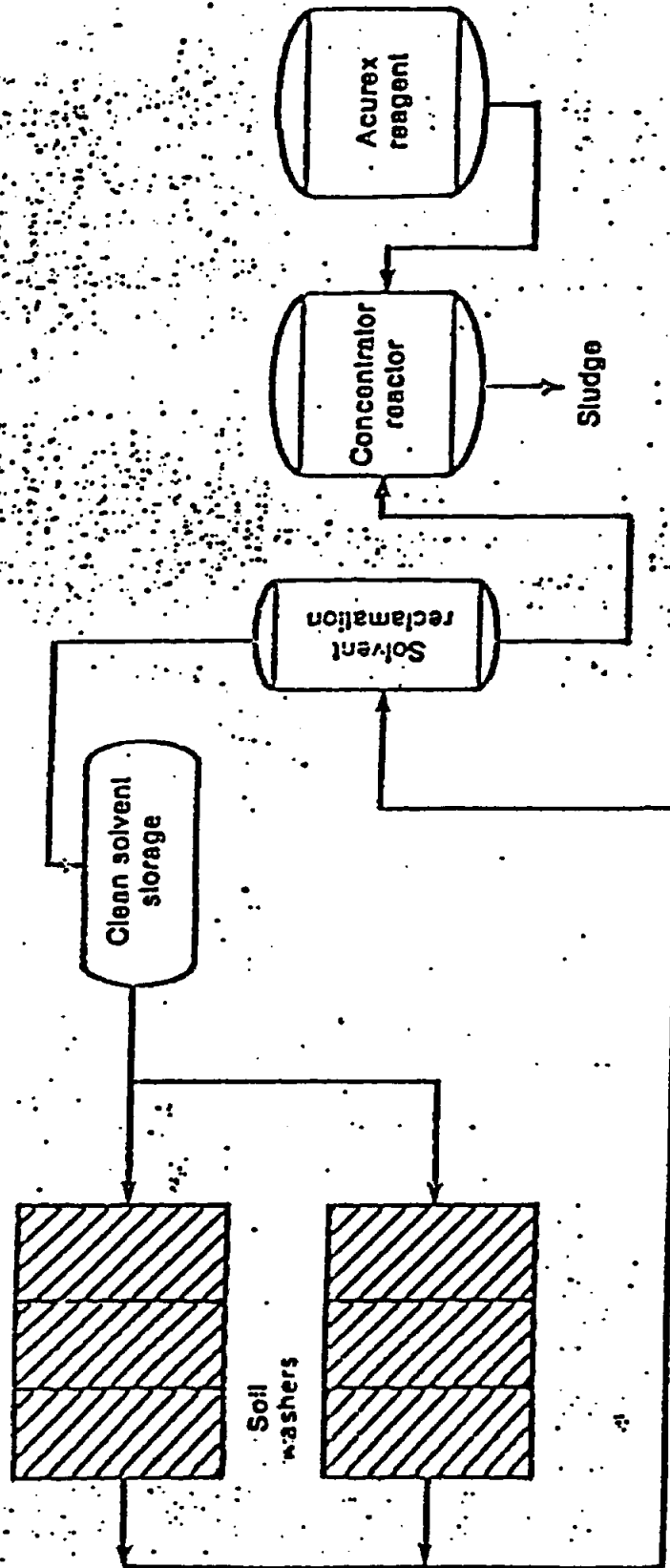


Figure 23. Acurex process — process flow diagram.

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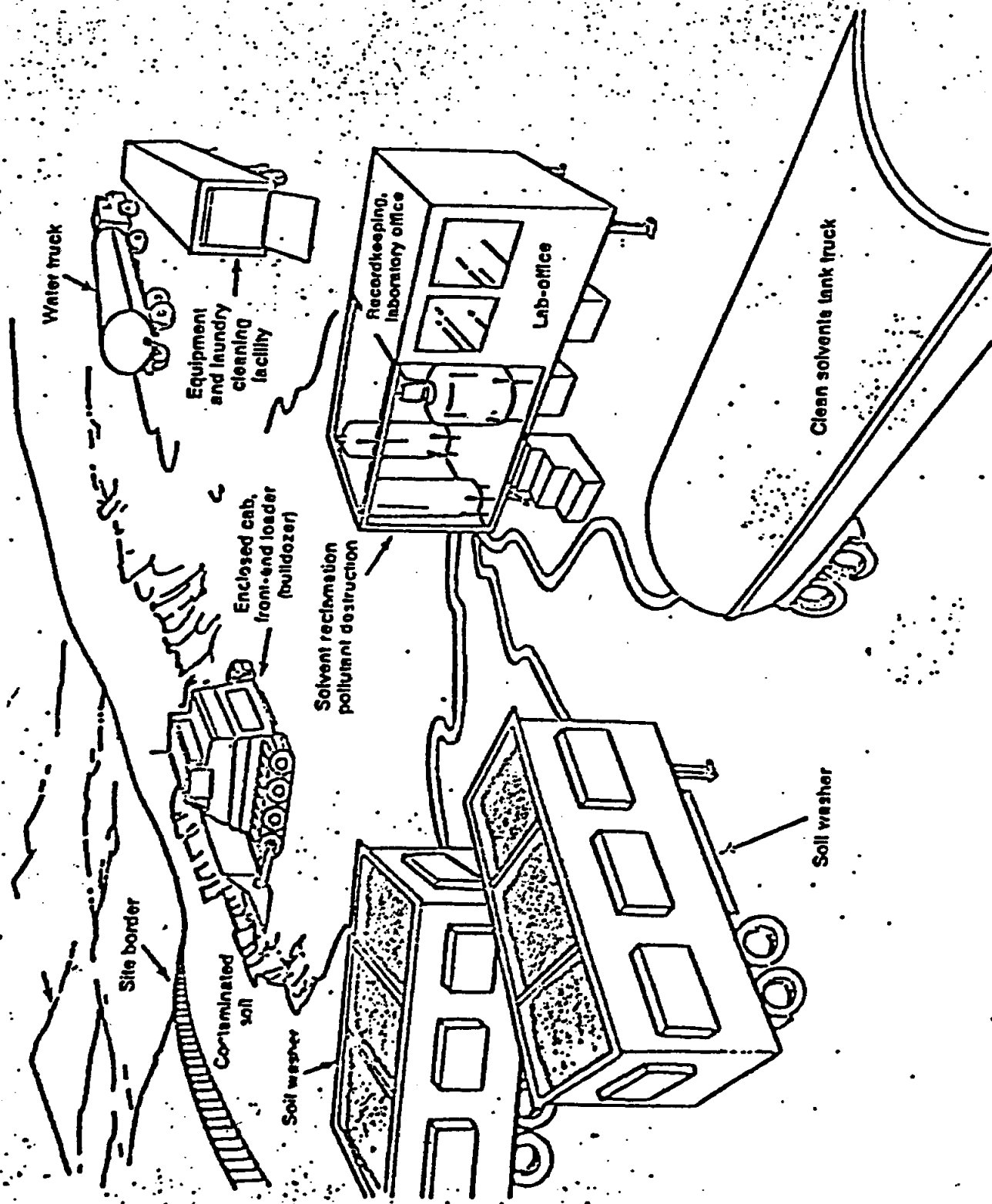


Figure 24. Typical site cleanup equipment.

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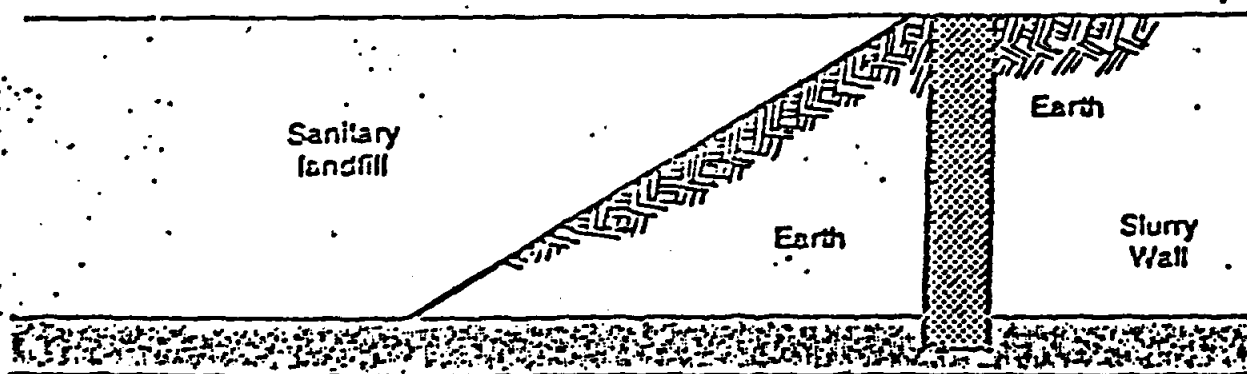
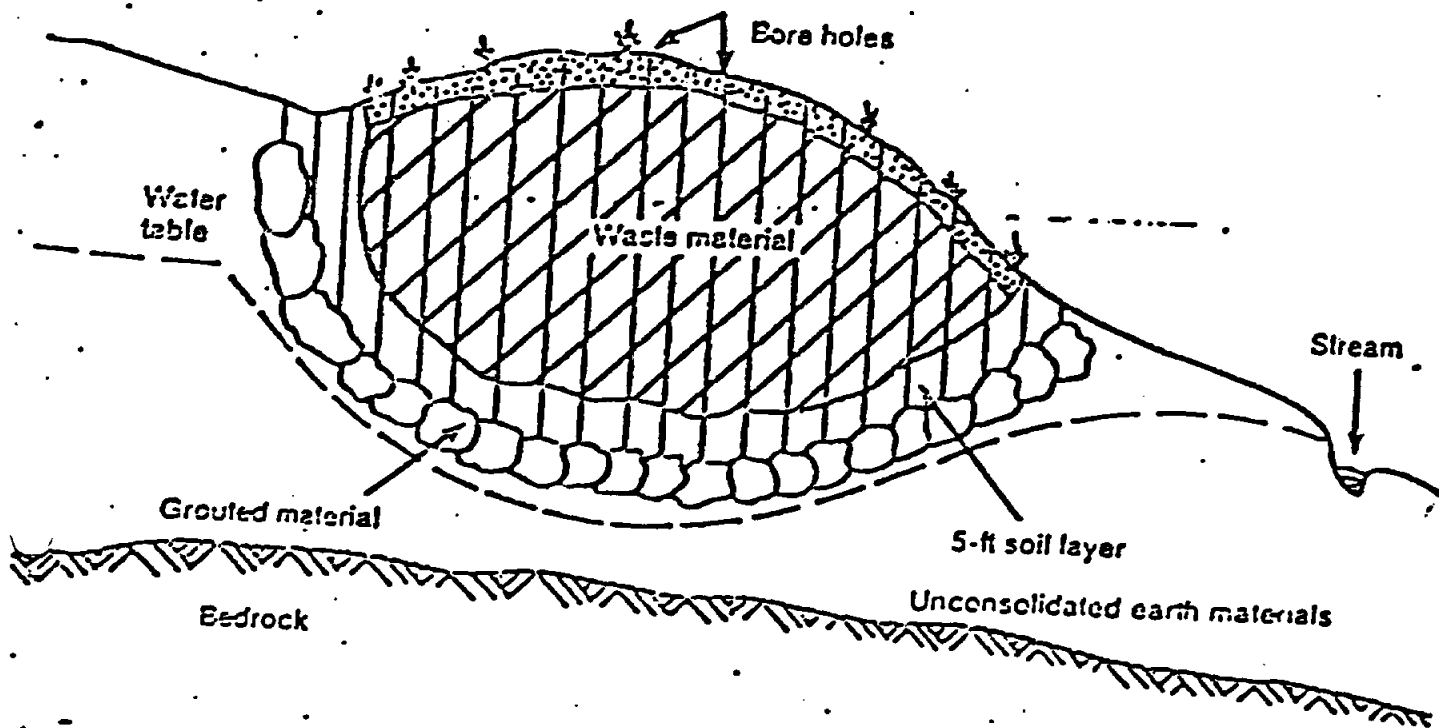


Figure 43. Typical application of a slurry wall.

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Source: Tolman et al, 1978

Figure 44. Cross-section of grouted bottom seal beneath a containment area.

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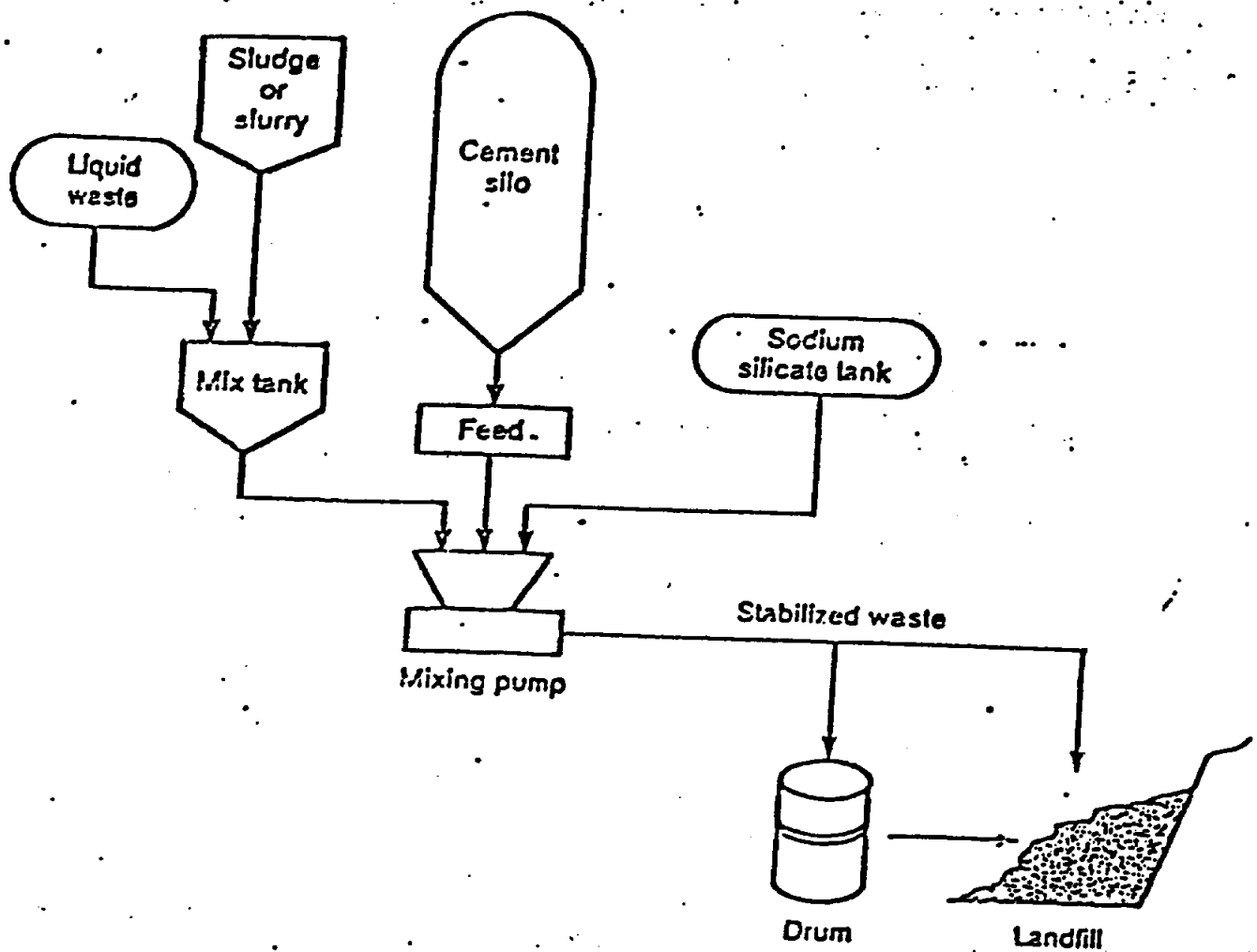


Figure 45. Cement-based stabilization process.

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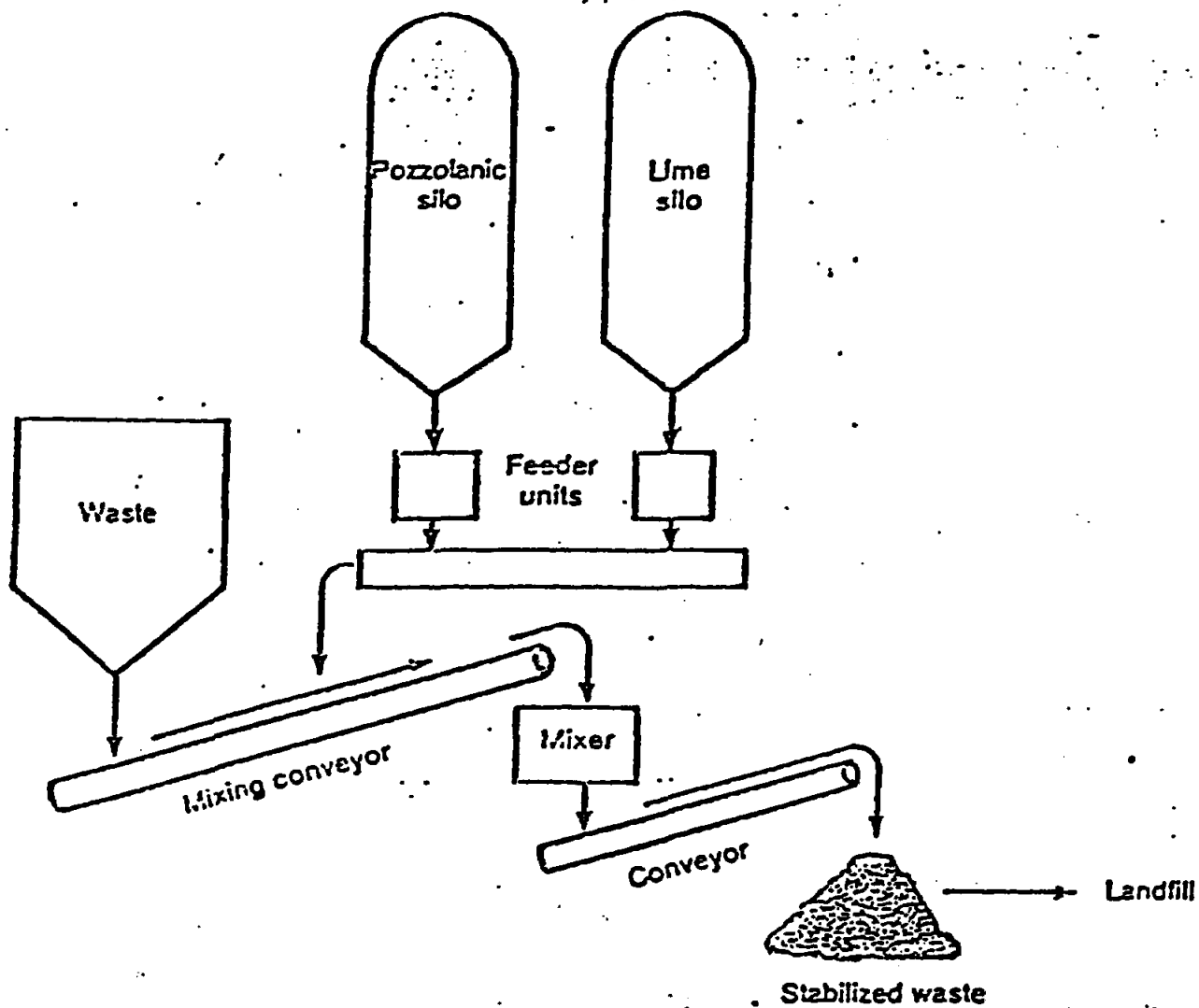


Figure 46. Lime-based (pozzolanic) stabilization process.

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